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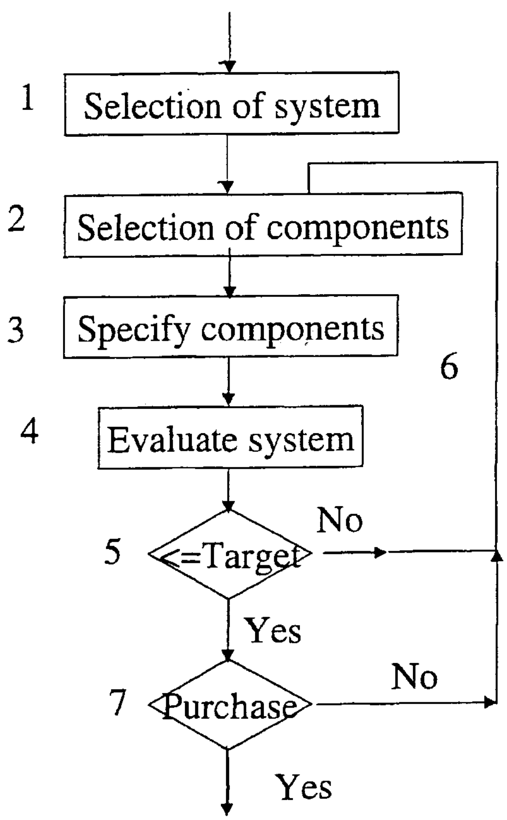
(54) Title: METHOD AND MEANS FOR PROCUREMENT OF AN INDUSTRIAL PRODUCT INCLUDING SPECIFICATION AND OPTIMISATION BY THE CUSTOMER



(57) Abstract: A method for procurement of an electrical apparatus in which at least one equipment specification is selected and at least one design parameter is calculated. For example a design parameter may be associated with such as, an environmental emission, whereby an environmental impact for said electrical apparatus is calculated. An equipment specification is sent to a purchase process so that a buying decision may be made. The optimized selected equipment specification may also be sent to manufacturers, suppliers when a buying decision is made. The advantage of the invention is that a factor such as the environmental impact of an electrical apparatus may be evaluated, optimised and the delivery time of the purchased, specified apparatus reduced.

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METHOD AND MEANS FOR PROCUREMENT OF AN INDUSTRIAL PRODUCT INCLUDING SPECIFICATION AND OPTIMISATION BY THE CUSTOMER.

BACKGROUND OF THE INVENTION

This description contains elements of an invention described in a PCT application SE 00/01757 filed September 11, 2000 which application is hereby incorporated in this description by reference. Parts of the said application are repeated in this description to facilitate understanding of the invention.

Technical Field of the Invention

The present invention relates in general to the procurement of an industrial product. Industrial product includes systems, apparatus and products within the areas of equipment in electrical generation, transmission and distribution technology, energy systems, industrial products such as building products, marine products, robots, control systems, motors, drives for control systems used in general industry, including the food industry, as well as in oil and gas extraction and refining, chemical processes, and mining. In addition are included plants and process equipment for production of semiconductors, Micro Electronic machine systems and Nano-machines. In particular the invention is a procurement method and means including a method for selecting and optimising specifications including design specifications for an industrial product.

Description of Related Art

The procurement of equipment and services in the field of industrial products requires that many design and performance factors have to be weighed and considered. As well as general performance, environmental emissions or environmental impact of an industrial product or electrical apparatus or system of given specification must be taken into account. This will be taken into

account while designing the industrial product. It will also be taken into account by a would-be purchaser and/or operator of a system or an electrical apparatus. A known approach to estimating one such design parameter, environmental impact, is to measure an environmental impact of an apparatus during a complete life cycle of manufacture, use or operation and disposal. The method is generally known as called Life Cycle Analysis, LCA.

Today, there are a number of different methods available for evaluating the results of Life Cycle Assessments (LCAs) for electrical systems, equipment and products. However, a significant problem with these evaluation methods is that they are based on a number of assumptions that are relatively complex and difficult to understand. An example of an energy supply system including an evaluation approach is disclosed in European Patent Specification EP 0 568 822 B1. However the evaluation disclosed is comprised in a system for optimising an energy output of a single generating unit in which an energy output is produced from a combination of different energy sources. The total energy output for that generating unit is optimised at least in part so as to achieve a low or minimised generation of environmental pollutants. However the application of this evaluation is limited to one generating unit and the basis for assigning what are called "energy costs" is difficult for a non-specialist to determine from the disclosure. Furthermore, conducting an entire LCA study is a complex undertaking that takes a substantial time to perform.

Recently, the results of LCAs have been used for marketing of electrical systems, equipment and products. In particular, LCAs have been used for evaluating the comparative impact of electrical systems, equipment and products in environmental terms. For example, ABB AB (formerly, Asea Brown Boveri AB) has introduced a new type of high voltage power generator called Powerformer (Trade mark) that can be connected directly to a power grid without a step-up transformer. In addition to the significant technical advantages associated with this new high voltage generation

technology, LCA studies performed by ABB AB indicate that the Powerformer also has a significantly lower environmental impact than that of a conventional system with a generator and step-up transformer. Moreover, LCA studies performed by ABB AB indicate that these environmental advantages can accrue not only while the Powerformer equipment is being operated but also during its manufacturing and disposal phases.

LCA studies have been performed that compare the environmental differences between the Powerformer and conventional power generating systems. As illustrated by the simplified schematic diagram shown in FIGURE 10A, the Powerformer plant is simpler and more compact than a conventional power generating plant, because the step-up transformer 4, associated circuit breaker 2 and surge arrester 3a are not required. Consequently, the Powerformer plant requires less space than a conventional power generating system, and a conventional oil-collection pit is not needed. Furthermore, because the Powerformer has fewer components than a conventional power generating system, the Powerformer plant's maintenance requirements are reduced and reliability is enhanced in comparison with conventional systems. As such, the environmental impact of the Powerformer plant is shown to be much lower than that of conventional power generating systems as will be described in detail below.

US 7,852,560 discloses an apparatus for assessing a load that industrial products apply to the environment. The apparatus described models and calculates a form of LCA analysis. Although it is stated to be for industrial products, what is described is in fact limited to consumer products which have been produced industrially. The apparatus is intended for use with electrical appliances, that is electricity consuming products, such as refrigerators, televisions and washing machines. However, even for electricity consuming products the apparatus is difficult for a non-specialist such as a general salesperson or ordinary customer to understand. Further, the end results produced, such as those

disclosed in table form comparing calculations by the apparatus with results from other LCA analyses for the same product, although meaningful in an academic context would be hard for a non-specialist to understand and evaluate their significance.

Thus a number of significant problems exist with the use of LCA studies and environmental parameters for marketing of electrical systems, equipment or products. As mentioned above, the different methods used for evaluating the results of such LCA studies are based on a number of hard to penetrate assumptions which make the results difficult for sales persons and customers to understand, and therefore, are less suitable for marketing purposes. In fact, both sales persons and customers have found it exceedingly difficult to interpret the results of even a simplified LCA study in this regard. Also, conducting an entire LCA study is a complex undertaking that takes a relatively long time to perform. Moreover, the different methods used for evaluating the results of such LCA studies use global data that is less relevant and over-averaged. Consequently, a significant need exists for a method that can be used to simplify the use of LCAs and environmental parameters and make them more suitable for marketing or otherwise assessing electrical systems, equipment and products.

In the area of industrial product procurement it has been common practice over the last 20-30 years for major manufacturing companies to communicate with customers and suppliers by means of computerised documents conforming to a standard known as Electronic Data Interchange (EDI). This standard is described in United Nations standards including EDIFACT and in US American National Standards Committee (ANSII) standards relating to EDI including Accredited Standards Committee (ASC) X12 standards for EDI. EDI has been characterised by expensive proprietary software, often custom software and complex, non standard implementation. With the emergence of the World Wide Web companies have begun to use user-friendly, open-standard, relatively inexpensive Web-browser technologies for purchasing by consumers, or Business to

Consumer, so called B2C, and for purchasing by other corporate entities, or Business-to-Business, so called B2B. Within B2B the use of computerised customer-supplier communication is expanding rapidly.

A US patent, US 5,960,411 issued to Amazon.com, Inc. describes a method to order a product over the Internet. In particular, the method and systems disclosed include method steps and computerised means to store details about an existing customer, associated with customer identification means such as a cookie, so that during future purchases the customer can purchase other products with a single action, "one-click", without having to re-enter address details identifying the customer. The method however discloses only how consumer products may be efficiently purchased over the Internet, and no account is taken of how design factors such as an environmental impact of the products, which products typically are already manufactured and finished products, may be lessened or performance improved.

Environmental impact is only one design parameter out of many possible significant design parameters taken into account when specifying an industrial product, especially if the industrial product is composed of many components, such as a system for generating electricity, an installation such as process equipment for oil extraction or a control system for a manufacturing plant. Industrial designers and engineers strive to offer a product that will meet the requirements of customers.

As described in detail below, the present invention successfully provides a method and means for procurement in which the design parameters such as the above-described environmental analysis and other design parameters affecting cost and performance related to an industrial product are solved.

SUMMARY OF THE INVENTION

In accordance with a preferred embodiment of the present invention, a method for purchasing an industrial product is provided which includes at least one evaluation of a design parameter of an apparatus specification for the industrial product.

One aim of the invention is to provide a purchasing method, and means for carrying out the method, in which an design parameter of an apparatus specification is calculated, such that the apparatus specification may then be included in a procurement process such as a request for a quote (RFQ) or a buying decision.

Another aim of the invention is to provide a method in which an valuation of a design parameter may be carried out on more than one apparatus specification or combination of apparatus specifications that can comprise the industrial product.

A still further aim of the invention is to provide a means to optimise a component selection and an apparatus specification with regard to at least one design parameter.

Another further aim of the invention is to provide a means where a purchasing customer can optimize, interactively, an industrial product such as a system comprising different components from one or more suppliers and optimize, component by component for example, the whole system according to his/her requirements and according to his/her preferred design parameters.

For example, a valuation method is included in one embodiment, to calculate a value of environmental cost as a design parameter of a power generating plant. The predominant emissions in the operation or use of power generating plants are assumed to be $C0_2$, NO_x and $S0_2$. An additional assumption made is that all electrical losses incurred during a plant' s operational or use phase are replaced

by "new" energy that is produced in a specific region, typically the region involved or a region nearby. For example, such a region can include a country, county, city, town, or larger geographical area (e.g., European Community, North America, South America, etc.). Also, a region other than the location of the plant may be selected to calculate 'what if" scenarios, such as, for example, US emissions data calculated against emission taxes from a Swedish region. As such, a database is provided that includes life cycle inventory data of energy mixes (e.g., need for resources, and emissions) or single fuels for various geographical regions throughout the world.

The energy mixes (or single fuels) of the different regions result in various amounts of the predominant emissions, CO_2, NO_x and SO_2 related to the energy losses incurred. The emissions related to the energy losses incurred during the operation of the power generating plant are then translated into monetary units. These. monetary units are associated with the environmental impact of the power generating plants being assessed. For this exemplary embodiment, the amount of emissions can be valued by such monetary costs as regional and/or national taxes imposed on emissions, retrofit costs (e.g., for converting coal-fired power plants to biomass power plants) in order to reduce emissions, restoration costs for environmentally degraded areas (e.g., restoring acidified lakes and soil, etc.), and emissions trading (e.g., plant owners trading for CO_2, SO_2 and/or NO_x, emission allowance certificates, etc). The monetary units (dollars, kronors, pounds, pesos, etc.) related to the environmental impact of operating different power generating plants are readily understood and can be compared for use in marketing of such systems, equipment or products. In other embodiments, the environmental impact of other electrical systems, equipment or products (e.g., power transmission and/or transformer systems and equipment, power distribution and/or power consumption equipment, etc.) are also translated to monetary terms and compared for marketing or other purposes.

An important technical advantage of the present invention is that the procurement method a stepwise component-by-component and apparatus specification-by-specification method to calculate one or more design parameter values for an industrial product in a way that is relatively easy to understand.

Yet another important technical advantage of the present invention is that an embodiment to purchase equipment is provided with an economic valuation of the environmental impact of electrical systems, equipment and products without the need to perform entire lengthy, complex Life Cycle Assessments.

Still another important technical advantage of the present invention is that one of more design parameters for industrial systems, equipment and products provided allows selection of different components and different apparatus specifications for a product or plant of interest to calculate "what if" scenarios. Moreover, a specification of the industrial product or part thereof may also be evaluated in one or more iterations to obtain a specification with one or more optimum design parameter values cost.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the method and apparatus of the present invention may be had by reference to the following detailed description when taken in conjunction with the accompanying drawings wherein:

FIGURE 1 shows a simplified flow chart of a procurement process for an industrial product in which a selection of components result in apparatus specifications which may be evaluated and the apparatus specification, if accepted, sent to a purchase process with a single action according to an embodiment of the present invention.

FIGUREs 2A and 2B are related flow diagrams of an exemplary method for a to evaluate an environmental impact of an electrical apparatus or system that can be used to implement an embodiment of the present invention;

FIGUREs 3A and 3B are related diagrams that show the consumption of material resources of copper and steel, respectively, used for manufacturing a Powerformer and a conventional system per MWh of electricity produced;

FIGUREs 4A and 4B are related diagrams that show, respectively, the global warming potential per MWh of electricity produced and acidification potential per MWh of electricity produced for the life cycle phases of the Powerformer and a conventional power generating system;

FIGURE 5 is a diagram that shows the weights of the predominant emissions, $C0_2$, SO_2 and NO_x per MWh of electricity produced during the Powerformer's and conventional system's different life cycle phases;

FIGUREs 6A and 6B are related diagrams that show the emissions to air which are related to energy losses made up for by the electricity generation mix for the United States, and by electricity generation from European stone coal, respectively;

FIGUREs 7A and 7B are related diagrams that show the emission costs incurred for the Powerformer and a conventional power generating system in $US/year related to the energy losses made up for by the electricity generation mix in the United States and by electricity generated from European stone coal, respectively;

FIGURE 7C is a schematic display of an application of an embodiment of the environmental cost evaluation included in an embodiment of present invention to a comparison of electrical generators;

FIGUREs 8A and 8B are related diagrams that show the present values of the emission costs related to energy losses replaced by the electricity mix in the United States and from electricity generated from European stone coal, respectively, for the Powerformer and conventional power generating system; and

FIGURE 9 is a simplified block diagram of a method that can be used to implement a second embodiment of the environmental cost evaluation included in an embodiment of present invention.

FIGURE 10a is a simplified schematic diagram of a Powerformer generating plant and a conventional power generating plant;

FIGURE 10b is a simplified diagram of a standard wind-driven generator and a second wind generator with a generator of the Powerformer type.

FIGURE 11 is a simplified diagram of components of a power generating and transmitting system including a wind-driven generator of the Powerformer type.

FIGURE 12 shows a simplified flow chart of a preferred embodiment of the invention in which notification of a decision to purchase an industrial product of a given specification is forwarded to a manufacturer.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The preferred embodiment of the present invention and its advantages are best understood by referring to FIGUREs 1-12 of the drawings, like numerals being used for like and corresponding parts of the various drawings where possible.

The procurement of equipment, manufacturing systems, processing systems and services requires the procurer to specify a number of design parameters for the purchased system. A procurement can follow a number of different paths dependent on the product/process/system that one wants to purchase. In the description of the invention we will describe how a purchaser will be supported by an online and substantially interactive application where the component parts of a system can be chosen and a selected component can be further specified. The user can evaluate a number of different design parameters, for example, system losses, total effect, price, cost, maintenance/service time-costs, financial cost of environmental emissions, availability, weight, total emissions, size requirement, land use, and so on dependent on the nature of the industrial product being procured.

See FIGURE 1. In the first step (1) when a prospective purchaser enters the system a number of possibilities are possible. It depends for example if a system such as a web-site is set up for one product or a range of products. In the general case the user can chose from a number of different system buildup areas.

When the type of system is selected, the use can select what components to use (2) to fulfill the requirements of the system.

When the components are selected additional specifications (3) on the components can be entered. When the system is described the system will use built-in algorithms and calculation functions to evaluate the system (4) and present the decision parameters.

Once all decision parameters are calculated the user can compare the value for the selected design parameter, such as cost, power output, weight etc to a constraint or target and make a decision (5) to continue with the optimization (6) by changing specifications and/or changing component types. The user can also decide that the system is optimal for him, and continue by and sending the specifications to suppliers for purchase (7), preferably by means of a single command or selection action.

Not shown in FIGURE 1 is that all the selections that the user performs are stored in a database. This database supports the user to trace the decisions (component choice, component specification) that are made during the optimization. Storing the choices the users make will also be stored for the benefit of the sales department to see what combinations the users look at.

Suitable built-in algorithm and calculation function means may include Mixed-Integer linear programming optimizations (MILP) or even Mixed integer nonlinear programming (MINLP) modules to support the user to search the space of possible solutions.
How this will work: Once the user have selected a design and evaluated it, he/she can the select one decision parameter and ask the system to improve the design for this parameter.
The system can furthermore support multi-objective/multi-criteria optimization by letting the user assign weights to decision parameters and optimize the system to improve all weighted decision parameters.

Referring to FIGURE 1, if a specification is accepted then it is sent into a purchase process by means of a single action. In the purchase process a price is calculated (or retrieved) and

displayed which is dependent on the specification accepted. An option to purchase, a buying decision, is then given.

By single action it is meant that the specification may be transferred to the purchase process directly by single selection or command action on the part of a user. For example on a computer screen displaying the financial environmental cost the user can select a:

-menu option from a click of a right mouse button,

-a menu option from a drop-down menu,

-click on a button suitably marked, eg, "Send specification to Purchase Process".

Once transferred to the purchase process the essential actions provided for the user to take are to;

-examine a price and conditions dependent on the apparatus specification and

-make a buying decision of Yes or No

for an industrial product according to the accepted specification.

It is necessary to point out that a purchase process according to the invention to procure a simple item such as a single electric motor, of an optimised selection of specifications such as horsepower, revolutions per minute, frame size etc. may display only one price and no or very few associated conditions. The invention also is applied to procurement of complex systems or arrangements of a plurality of apparatus. Traditionally such larger purchases involve negotiation over prices and conditions offered, in which part of the purchase process may also comprise stages of direct contact and/or a face-to-face meeting between a selling company representative and a prospective customer.

Environmental cost as a design parameter.

Essentially, in accordance with an embodiment of the present invention, is included a method for economic valuation of the environmental impact of electrical systems, equipment and products, whereby the predominant environmental parameters related to the use of the electrical systems, equipment and products are translated into monetary terms. For example, in the preferred embodiment, the predominant emissions in the operation or use of power generating plants are assumed to be CO_2, SO_2 and NO_x. Other emissions such as particle emissions, Volatile Organic Compounds (VOC), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) may be similarly or alternatively evaluated. An additional assumption made is that all electrical losses incurred during a plant's operational phase are preferably replaced by new energy produced in a specific region. As such, a database is provided that includes life cycle inventory data of certain energy mixes (e.g., need for resources, and emissions) for various geographical regions throughout the world. The energy mixes of the different regions (can also include only one fuel in certain regions) result in various amounts of the predominant emissions, CO_2, SO_2 and NO_x, related to the energy losses incurred. The emissions related to the energy losses incurred during the operation or use of the power generating plant are then translated into monetary units. These monetary units are associated with the environmental impact of the power generating plant. For the preferred embodiment, the amount of emissions can be valued by such monetary costs as regional and/or national taxes imposed on emissions, retrofit costs (e.g., for converting coal-fired power plants to biomass power plants) in order to reduce emissions, restoration costs for environmentally degraded areas (e.g., restoring acidified lakes and soil, etc.), emissions trading (e.g., plant owners trading for CO_2 emission allowance certificates, etc). The monetary units (dollars, kronors, pounds, pesos, etc.) related to the environmental impact of operating different power generating plants are readily understood and can be compared for use in the marketing of such equipment. In other embodiments, the

environmental impact of other electrical systems, equipment or products (e.g., power transmission and/or transformer systems and equipment, power consumption equipment, etc.) can also be translated into monetary terms and compared for marketing or other purposes.

Specifically, FIGUREs 2A and 2B are related flow diagrams of an exemplary method 100 that can be used to implement an evaluation of one design parameter according to the present invention. The flow diagrams shown in FIGUREs 2A and 2B represent an algorithm that can be implemented in proprietary or commercially available software and executed by an appropriate digital processor, such as, for example, a processor in a personal computer, lap top, notebook, general purpose computer, mobile or fixed terminal, etc. In this regard, a user can implement the method 100 locally (e.g., on a personal computer) or remotely (e.g., from a terminal connected to the processor via a private network or a public network such as the Internet) using an Internet embodiment as described below.

For this embodiment, the method shown in FIGUREs 2A and 2B can be implemented with a standard spreadsheet application software or similar package. In a different embodiment, the method shown in FIGUREs 2A and 2B can be implemented as software suitable for use over the Internet, such as, for example, an applet, executable application or agent, which is written or programmed in an object oriented program language with object oriented code such as Java (Trade Mark) and/or Smalltalk (Trade Mark). The method can also be implemented at least in part via a telephone with a fixed or wireless connection to a telephone or data network. This is best carried out using a telephone suitably equipped for communication with digital networks such as by means of Wireless Application Protocol (WAP), I-Mode or Bluetooth enabled. Such a telephone may be used to display information and provide interactive communication with an Internet embodiment of the invention. It is equipped to manipulate information from the purchase process and

make choices or issue commands to specify components, apparatus specifications, run evaluations, proceed to a buying decision and to buy or not buy by means of menu-driven software and preferably software enabled for graphic manipulation of symbolic means displayed by the telephone based on HTML, XML, similar or other software.

The embodiment also includes for the purpose of environmental evaluation a relational database (not explicitly shown) of selected inventory items. The database can include detailed information related to the environmental impact of electrical systems, equipment or products, such as, for example, data related to the extraction of raw materials (e.g., mining, oil extraction, etc.) used in the manufacture of electrical products, energy consumption of electrical products, manufacturing processes for electrical products, transportation of the materials and components for electrical products, waste by-products associated with the manufacture, use and disposal of electrical products, degree of disposal and recycling of materials from electrical products, etc. Preferably, a relational database is used (but not necessarily required), because a relational database can handle relatively large sets of data in an effective and secure way, and can be a very powerful tool for searching for and collating information.

For the environmental design parameter evaluation embodiment, the database also includes regional information about the characteristic electricity blends for each region or country to be analyzed. For each characteristic regional electricity blend or mixture, the database includes information about specific amounts of the predominant emissions(e.g., CO_2, SO_2 and NO_x) output per kiloWatt hour (kWh) due to power generation in that region. For this embodiment, a characteristic electricity blend or mixture is represented by an average value for the electricity produced in a region over an entire life cycle of the system, equipment or product involved. For example, the database can include

characteristic electricity blends or mixtures for regional oil-fired power generation, where oil extraction, transport, refining, flue gas cleaning, and average values of efficiency are factors that can be considered. Also, for certain regions, the database can include a single fuel instead of a blend or mixture.

Alternatively, the energy mixes can include simpler data such as energy produced, or emissions released per state, region or city without using data from an entire LCA (e.g., emissions from a complete life cycle are more complicated data). Examples of such energy mixes are provided by the United States Department of Energy the partial address of which on the web is: eia.doe.gov/cneaf/electricity/st_profiles/toc.html

Returning to FIGUREs 2A and 2B, at step 102 of the evaluation method, a user can select an electrical apparatus, electrical technology application (or combination of technology applications) to be analyzed. In one embodiment, the electrical power generation application 104a is selected. As such, the flow diagram shown in FIGURE 2B is directed more clearly to this embodiment.

However, the present invention is not limited only to power generation applications and can also include other types of industrial products, such as, for example, power transmission, power storage and transformer applications 104b, or applications whereby the equipment consumes electrical power (e.g., motors, solenoids, power supplies, resistive heating units, inductive devices, instruments, building control systems, control systems for process control, manufacturing plants, refineries etc.) 104c. Notably, another embodiment of the present invention, which can be used for assessing electrical consumption products such as small motors, is described in detail below. In any event, as illustrated by the flow diagram shown in FIGUREs 2A and 2B, the steps for economic valuation of the environmental impact of electrical systems, equipment or products are similar for each of the different embodiments shown (power generation 104a, power

transmission and transformation 104b, and power consumption 104c). For the present embodiment, the power generation application 104a is selected.

At this point, it is useful to describe some details about the power generation plants used in the preferred embodiment to illustrate the present invention. As mentioned above, for this embodiment, the environmental impact of the Powerformer plant is compared with that of a conventional power generating system (see FIGURE 10a). The Powerformer and conventional power generating system in the following specific example are both configured for connection to a 130 kV transmission network. In this regard, the apparent power of the Powerformer is 128 MVA, and that of the conventional generator is 136 MVA. The power efficiency of the Powerformer is 98.5%, and that of the conventional generator is 98.4%. The power factor for the Powerformer is 0.95, and that for the conventional generator is 0.9. The apparent power of the conventional system's step-up transformer is 350 MVA, and its power efficiency is 99.47%. As such, the Powerformer is configured to provide the same active and reactive power to the grid as that provided by the conventional system with its generator and step-up transformer. The basic functional unit for the Powerformer and conventional generating system is 1 MWh of electricity.

For this embodiment, the materials inventory in the relational database for the Powerformer includes the generator 10, surge arrester 13, and cables up to, but not including, the high voltage switching equipment. The inventory in the relational database for the conventional system includes the generator 1, step-up transformer 4, surge arresters 3a, 3b, subsequent transformers (not shown), and conductor rails. Since the Powerformer requires no step-up transformer and certain other components required by the conventional system, the Powerformer needs less material during manufacture than the conventional system, and therefore, the Powerformer has less material to dispose of at the end of its life cycle than the conventional system. Furthermore, the

Powerformer uses cross-linked polyethylene (XLPE) for insulation, which is more environmentally friendly than the epoxies used for insulation in the conventional systems.

FIGURES 3A and 3B are related diagrams that show the consumption of material resources of copper and steel, respectively, used for manufacturing the Powerformer and conventional system per MWh of electricity produced. As shown, the consumption of copper is higher during the manufacture of the conventional system than for the Powerformer, but the opposite is true for the consumption of steel.

For the present embodiment, the energy losses (in kWh) for the Powerformer and conventional system (for the example previously described for connection to a 130 kV transmission network) are calculated from their respective power efficiency and power factor values. The operational period for both plants is set to 30 years. In an example taken from a particular service pattern, a service life of 30 years and some thousands of hours per year are determined using a planned load pattern.

A prospective utility might, for example, specify 1,000 hours at 50% load, 2,000 hours at 75% load, and 2,000 hours at 100% load. From the annual hours at a specific load, the total electrical losses incurred while operating the Powerformer in this example for one year are 15,814 MWh and 474,422 MWh for 30 years. The electrical losses incurred while operating the conventional power generating system for one year are 22,962 MWh and 688,864 MWh for 30 years. Notably, these energy losses are higher in the conventional system than in the Powerformer primarily because of the step-up transformer's energy losses.

For the present embodiment, it can be assumed that at the end of the useful life of the Powerformer and conventional power generating system, all metallic material in the generator is

recycled, polymers are incinerated, and the remaining material is disposed of appropriately.

The environmental impact from energy losses is incurred when the losses have to be replaced by energy produced by other electricity sources in a region. In this regard, it can be assumed that the fraction of electricity generated from different sources within a region are constant for a relatively long period of time. However, the electricity mix can vary substantially from region to region. For example, electricity is produced in Sweden with approximately 52% hydro-electric power, 44% nuclear power, and 4% fossil fuels. On the other hand, electricity is produced in Germany with approximately 62% fossil fuel, 34% nuclear power, and 4% hydro-electric power.

The power generating system resources and emissions data can be grouped into a number of environmental impact categories in the relational database. These categories describe such effects as global warming (greenhouse effect), acidification, and ozone depletion. For example, SO_2 and NO_x emissions are included in the acidification impact category. As such, FIGUREs 4A and 4B are related diagrams that show, respectively, the global warming potential per MWh of electricity produced and acidification potential per MWh of electricity produced for the life cycle phases of the Powerformer and conventional power generating system. As illustrated by FIGUREs 4A and 4B, the use or operational phase for both the Powerformer and conventional system is the predominant phase. In other words, the largest impact on the environment is incurred during the operation of each plant, which is due to the relatively long operating time covered (many years). As such, the manufacture of the Powerformer and conventional system plays only a minor part in the environmental impact incurred over their entire life cycles.

The environmental impact of the operational losses incurred depends on the manner by which the electricity is generated. For

this exemplary embodiment, it is assumed that loss compensation is carried out with an electricity production mix in the United States, which is based on approximately 20% nuclear power, 10% hydro-electric power, and 70% fossil fuel. As such, the contribution to global warming is primarily from CO_2 emissions. other gas contributors to global warming are CH_4 and N_2O. As such, CH_4 and N_2O emissions are usually less important as contributors to global warming and are disregarded in this exemplary embodiment. Alternatively, CH_4 and NO_x may be expressed as CO_2 equivalents.

Referring again to FIGURE 4A, it can be seen that the conventional power generating system has a higher global warming potential than the Powerformer. However, the gas contribution to acidification comes from SO_2 and NO_x emissions. As an alternative, the environmental impact values for such gases as NO_x can be expressed as SO_2 equivalents. Referring again to FIGURE 4B, it can be seen that the conventional power generating system has a higher acidification potential than the Powerformer.

FIGURE 5 is a diagram that shows the weights of the predominant emissions, CO_2, NO_x and SO_2 per MWh of electricity produced during the Powerformer's and conventional system's different life cycle phases. As shown, the conventional power generating system produces higher levels of emissions to air than the Powerformer.

Returning to the flow diagram shown in FIGUREs 2A and 2B, for this embodiment, at step 106a, a user selects one or more technical performance parameters as input data for calculating energy losses for the power generating systems involved. These performance parameters can include, for example, power efficiency at different loads, load cycle information, system availability, and rated power. As such, based on the above described information, the following assumptions can be made: (1) increased efficiency leads to lower losses that replace regionally produced electricity; (2) the fraction of electricity generated from different sources in a

region varies only slightly over a relatively long period of time; the environmental impact of a power generating system is dominated by its operational or use phase; and the emissions of $C0_2$, $S0_2$ and NO_x produced during the use phase of a power generating system dominate its environmental impact. Given the above information, the economic valuation of the environmental impact of power generating systems can be simplified by including only those energy losses incurred during the use phase for a system,15 and the predominant air emissions Of $C0_2$, NO_x, and $S0_2$. Also, for illustrative purposes, it can be assumed that the energy losses incurred are replaced either by electricity produced in the United States or by electricity generated from European stone coal.

At step 108, the user selects, as an electrical apparatus, the power generating systems to be evaluated. For the present embodiment, one system selected (108a) is the Powerformer, and the second system selected (108a') is a conventional power generating system. However, the present invention is in no way limited only to a method for economic valuation of the environmental impact of power generating systems but is applicable to other electrical systems, equipment or products such as, for example, power transmission systems, power storage means, power transformers, engines, motors, or systems composed of combinations of the same.

At step 110a, the energy losses per relevant time period (kWh) are calculated for each of the power generating systems involved. In this example, the energy loss calculations are based on one year's operation. As such, FIGUREs 6A and 6B are related diagrams that show the emissions to air which are related to energy losses replaced by the electricity generation mix for the United States, and by electricity generation from European stone coal, respectively. As shown in FIGURE 6B, a large amount of fossil fuel in the energy production mix results in relatively high levels of emissions to the air.

At step 112, the user selects a region for a specific blend of electricity and its emission profile, in order to calculate the environmental impact costs for the system(s) being assessed and/or compared. This region could be a number of countries, one country, or a region within a country. In this example, it is assumed that the losses calculated in step 110a are to be replaced either by electricity from the United States, or by electricity generated by European stone coal. As such, FIGUREs 6A and 6B are related diagrams that show the emissions to air which are related to energy losses replaced by the electricity generation mix for the United States, and by electricity generation from European stone coal, respectively.

As shown in FIGURE 6B, a large amount of fossil fuel in the energy production mixture results in relatively high levels of emissions to the air. As shown in FIGURE 2B, the emissions from a region are represented as kg emitted per kWh.

At step 114, the user selects the economic valuation method to be used for assessing the power generation system(s) involved. For this embodiment, the valuation of the regional effects of emissions is performed according to Swedish authority, whereby the cost for CO_2 emissions is set at 0.05 $US/kg, the cost for NO_x emissions is 5.4 $US/kg, and the cost for SO_2 emissions is 2 $US/kg. As such, for this embodiment, the values used for the nitrogen oxide emissions correspond to the regional fees imposed for emissions from large combustion plants. The values used for CO_2 and SO_2 emissions are based on national and/or regional political decisions regarding taxes on emissions. Again, these values can be based on one or more environmentally-related costs, such as taxes imposed on emissions, costs to repair environmental damage, retrofit costs, trading of future emissions, etc.

At step 116, the environmental costs for the energy losses incurred for the power generating system (s) being assessed are calculated according to the formula:

$US/kg (from step 114) *kg emitted/kWh (from step 112)*kWh (from step 110a) = $US. As such, FIGUREs 7A and 7B are related diagrams that show the emission costs incurred for the Powerformer and conventional power generating system in $US/year related to the energy losses replaced by the electricity generation mix in the United States and by electricity generated from European stone coal, respectively. As shown, for the economic valuation performed in this embodiment, the environmental cost for the Powerformer is lower than that of the conventional system. This results from the fact that the Powerformer has a higher power efficiency than the conventional system, and consequently, the Powerformer incurs lower energy losses during its operation than those incurred by the conventional power generating system.

FIGURE 7C is a schematic display of an application of an embodiment of the present invention to a comparison of electrical generators. Referring to FIGURE 7C, it can be seen how data input in various fields in order results in a comparison of the environmental cost for two generators. For this example, the fields shown in FIGURE 7C can be associated with the following steps of the method shown in FIGUREs 2A and 2B: the Input and Losses fields (7106) can be associated with step 106a; the Choice of region field (7112) can be associated with step 112a; the Choice of evaluation model (method) field (7114) can be associated with step 114a; and the Results field, (7116) can be associated with step 116a. The cost ($US) is shown in the Environmental cost box beside the selected currency.

Returning to FIGURE 2A. At step 118, the present values for the environmental costs from step 116 are calculated. FIGUREs 8A and 8B are related diagrams that show the present values of the emission costs related to energy losses replaced by the electricity mix in the United States and from electricity generated from European stone coal, respectively, for the Powerformer and conventional power generating system. The results for a United States energy mix (FIG. 8A) and European stone coal

(FIG. 8B) show the resulting savings under the heading 'Difference" and are values expressed in $US millions. For this embodiment, the present values shown have been calculated using an annual interest rate of 4% and an operational period of 30 years. As shown, these monetary values represent the environmental impact of the power generating systems being assessed and/or compared. Also, these monetary values are readily understandable and relatively easy for sales persons and customers to use for marketing or other purposes.

This present value of the cost is a result of the environmental cost valuation at step 1202 of FIGURE 1 which is sent considered at step 1203. If the environmental cost is accepted, the specification that the cost resulted from is sent forward in step 1204 to the purchase process where a price, or one or prices and associated conditions, will be displayed for the generating system or apparatus so that a buying decision can be made at step 1207 in FIGURE 1.

FIGURE 9 is a simplified block diagram of a method that can be used to implement a second embodiment of the present invention. For this embodiment, a method is provided for performing an economic valuation of the environmental impact of an electrical consumption product. As such, the method can be used to compare the environmental "cost" of small electric motors, such as, for example, motors that drive refrigerator compressors. Referring to FIGUREs 2A and 9 (FIGURE 9 is directed to the consumption part of the method shown in FIGURE 2A), at step 102 of the method, a user selects the electrical consumption application (104c) to be analyzed.

At step 106, a user selects one or more technical performance parameters as input data for calculating energy usage for the power consumption products (motors) involved. For this embodiment, these technical parameters include a rated power of 5.5 kW for each product, a life span of 50,000 hours for each product, an

efficiency of 90.5% for one product 108 (a high efficiency electric motor manufactured by ABB), and an efficiency of 85% for the second product 108c' (a standard efficiency electric motor).

At step 110c, the energy usage per relevant time period (kWh) is calculated for each of the power consumption products involved. For this embodiment, the energy usage calculations are based on 50,000 hours operation. The energy usage calculations begin by first calculating the input power for each product being analyzed: input power = output power/efficiency.
For the ABB product, the input power equals 5.5kW/0.905 or 6.08kW. For the competitor's product, the input power equals 5.5kW/0.85 or 6.47kW. Next, the energy used by each product is calculated: energy used = input power*life span.
For the ABB product, the energy used equals 6. 08kW*50,000h or 304,000kWh. For the competitor's product, the energy used equals 6.47kW*50,000h or 323,500kWh.

At step 112, the user selects a region for a specific blend of electricity and its emission profile, in order to calculate the environmental impact costs for the product (s) being assessed and/or compared. For this embodiment, Germany has been selected as the region. As shown in FIGURE 9, the emissions for a region are represented as kg emitted per kWh. As such, in Germany, the emitted CO_2 per kWh (from the electricity blend) is 0.64 kg/kWh.
At step 114, the user selects the economic valuation method to be used for assessing the power consumption product(s) involved. For this embodiment, the valuation of the regional effects of emissions is performed according to German authority, whereby the cost for reduced CO_2 emissions is 0. 021 $US/kg. As such, for this embodiment, the values used for the carbon dioxide emissions are based on the retrofit costs incurred for converting a coal-fired plant to a biomass plant.

At step 116, the environmental costs for the energy usages incurred for the power consumption product(s) being assessed are calculated according to the formula:

$US/kg (from step 114) *kg emitted/kWh (from step 112)*kWh (from step 110a) = $US.

As such, for the ABB product:

0.021 $US/kg*0.64kg/kWh*304,000 kWh = 4,086 $US.

For the competitor's product:

0.021 $US/kg*0.64kg/kWh*323,500 kWh = 4,348 $US.

For this embodiment, the economic value of the environmental impact of the ABB motor is less costly than that of the competitor's product.

Again the cost or present value of the cost would be the result of the environmental cost valuation at step 1202 of FIGURE 13 which is sent considered at step 1203. If the environmental cost is accepted, the specification that the cost resulted from is sent forward in step 1204 to the purchase process where a price (or associated condition or more than one price) is displayed, following which a buying decision can be made at step 1207.

Another application of the present invention is to economically evaluate the environmental performance of electrical systems comprising non traditional energy sources, energy storage means and transmission or distribution means. FIGURE 10b shows for example a wind-driven generator of a conventional type 1001, and a wind-driven generator with a generator of the Powerformer type 1005. The conventional wind-driven generator comprises a gearbox 1002 to increase the rotational speed of the wind turbine so as to drive a standard generator 1003 to produce a low voltage AC current. The voltage produced is then stepped up in a transformer 1004 and then connected via a transmission line to a power network.

The Powerformer type wind driven generator 1005 uses a permanent magnet rotor in the Powerformer type generator 1006. It requires

no gearbox, operates at variable speed and generates a variable high voltage AC current directly from the rotation of the wind turbine. FIGURE 11 shows a Powerformer type wind driven generator 1005 which is in this example placed out to sea. The technology makes it possible to build offshore wind farms with capacities ranging from 6 to more than 300 megawatts (MW). In a simplified representation the wind driven Powerformer generator 1005 is shown, with a passive diode converter 1101, and a DC cable link 1102 to land. On land a DC/AC converter station 1103 is shown. High voltage AC is then transmitted by a cable link to a power network 1104.

In the Powerform type wind generator the low frequency alternating current generated is converted by the passive diode rectifier 1101 to direct current (DC), which is transmitted via cables to a land-based converter station, where the direct current is converted back to sinus formed alternating current for feeding to the high-voltage grid. The energy generated is transmitted via the land-based converter station to the high-voltage grid without the need for an offshore platform for a transformer and switchgear.

The invention may applied to evaluate economically an impact of environmental loads or emissions from a wind driven Powerformer generator of the type described above. The method may be applied to a complete system of generator, DC cable, converter station, DC cable to grid and compared with, for example; a biomass fired power station; a conventional oil, coal, or nuclear-fired power station, with transformer, and with transmission lines to grid; or alternatively with a standard type of wind-driven generator and system.

Another example to economically evaluate the environmental performance of electrical systems is the evaluation of arrangements of electrical apparatus comprising renewable energy sources such as solar cells, heat pumps, wave energy machines.

Further, the invention may be used to evaluate the performance other energy generators such as fuel cells and microturbines.

Another, further example is the evaluation of systems comprising an energy storage means. The energy storage means may comprise a traditional technique such as a battery system for storing electrical charge, or water management means such as, pumps, reservoirs and turbines for storing kinetic energy for later re-use or energy conversion. A storage means may also comprise a gas management means, such as pumps, vessels and recovery or conversion means such as turbines, engines, reactor apparatus or fuel cells.

In the field of electrical transmission and distribution, a new type of transformer has been produced by ABB. It is called Dryformer (Trade Mark). The Dryformer uses insulation technology from the Powerformer generator. It is a transformer in which at least one winding comprises an insulation system consisting of a inner semiconducting layer in electrical contact with a conductor, an outer layer of semiconducting material at a controlled electrical potential along its length and an intermediate layer of solid electrically insulating material positioned between the inner and outer layers. This environmentally friendly transformer, and circuits or arrangements including the transformer may also be evaluated to calculate or compare a financial cost of an impact of environmental loads or emissions systems including a Dryformer.

As described previously, the method shown in FIGURE 1, and other parts of the method shown in FIGs 2A and 2B, is implementable as software suitable for use over the Internet by means of Hypertext MarkUp Language (HTML) code, Java (Trade Mark) programming, eXtensible Markup Language (XML) pages and the like open standard web browser and Transmission Control Protocol/Internet Protocol (TCP/IP) techniques. In an advantageous use of the invention, one or more software implementations of the method may be arranged accessible from and connected to an Internet based system for

marketing and sales of industrial products and systems. By this means a prospective customer can browse information about an industrial product, and

-select an industrial product

-select component comprising that product or system

-select an apparatus specification for the industrial product

-select a link to the design parameter calculation for the present industrial product and apparatus specification. Preferably this is carried out by means of web pages provided by a web server through a web site wherein the values of design parameters for an industrial product may evaluated according to the methods described above. The user may then send an accepted apparatus specification to a purchase process for a price and a subsequently to make a buying decision at step 1207. Such a buying decision that may be applied to a relatively simple purchase decision such as a motor or to a relatively complex procurement process such as a power generation or distribution system.

Preferred embodiments

FIGURE 13 also shows that an environmental cost valuation for a selected electrical apparatus may be re-run. If the environmental cost at step 1203 is too great, for example greater than a target cost, then at step 1206 a different emission parameter or equipment specification may be adopted and evaluated in the environmental cost valuation at step 1202.

In a preferred embodiment of the invention, specifications may be changed and the environmental cost valuation re-run a plurality of times until an iteration produces a cost that is acceptable according to a pre-determined value. This may be carried out by a human user or by a computer or computer program accessing the procurement means.

Each specification change per user per electrical apparatus selected is advantageously stored in a user history database 1211, as indicated in FIGURE 13. Data from all choices may be stored, including equipment selections, specifications and specification changes for decisions not to buy. By this means, a user may return to a web site at a later date and review, re-analyse or continue with evaluation of changes to a specification. The individual user history is associated with a logged in user by means of known identification means such as password, stored digital file or marker such as a cookie stored on the user machine, or combinations of identification means.

Individual user histories stored in the user history database are also aggregated and analysed for trend information about types of product and types of product specification that are of interest to users browsing the product information. This information is used to improve the effectiveness of the web site and other marketing means as well as to adjust the products and specifications offered to provide products and specifications that match customer demand.

FIGURE 13 shows a further and more preferred embodiment of the invention. Upon acceptance of an environmental cost valuation at step 1204, the specification is sent to the purchase process as before. A negative buying decision will be stored in the user history database 1211 together with specification changes. In this more preferred embodiment, a positive buying decision at the displayed price, or prices/condition package, results in the specification being sent to the manufacturer (or each more manufacturer or supplier in the case of a plurality or a chain of suppliers) at step 1209 of FIGURE 13. Thus the manufacturing process and necessary communications to suppliers so as to manufacture and provide a product that has been:
-selected,
-specified,
-optimised with respect to environmental impact,
-purchased
by the customer may begin straight away.

Simultaneously a copy of the information is sent to a Sales and Marketing process for coordination purposes, shown diagrammatically as step 1210 of FIGURE 12.

Wind Generator Park example

A system for wind generation may be evaluated according to many design parameters. For example to evaluate a design parameter of installation cost related to civil works. The method may be applied in this way:
-select wind park output, say 10 MW
-select generator components, say 3 Windformer (Trade Mark) generators,
-each generator output, 3,3 MW
-civil works, foundation and tower at sea, 3 units
-civil works, DC cable to shore, 3 units

The design parameter of costs for civil works for apparatus specifications based on the above may be calculated and a result displayed, which may be
-accepted and sent to a purchase process
-accepted and stored as part of a complex multi-stage evaluation process,
-specifications altered and the evaluation re-run.

Semiconductor Factory example

When supplying process equipment for a manufacturing plant many design parameters are involved. One such design parameter involved in the construction of a plant for producing semiconductors, or nano-machines or micro-electronic machines is air quality. The cost of clean room type facilities is very high, and becomes extremely expensive for large volume installations.

A prospective customer for a nano-component factory, or a factory for making semiconductors will be able run an evaluation similar to the following example.

Factors included in component selection:
plant Output, kg per yr,
one unit of process equipment output,. kg.per yr.,
number of process equipment units required for output,
volume requirement per process equipment unit,
air change requirement per process equipment unit,
air change requirement for ancillary clean space,
minimum volume requirement for given total plant output,
clean room air handling requirement value, m per sec.

The prospective customer in this example according to the invention is able to select a design parameter, select components, select apparatus specifications, optimize a selection interactively, and select, in this case, a size of manufacturing plant, for a given output, with a minimum volume requirement for clean air.

The apparatus specification for the industrial product sent to the manufacturer as a result of a single action by a purchaser is preferably in the form of an order or purchase order. The most preferred type of order is a purchase order as an open standard document, using for example a type of XML file. Preferably the purchase order also conforms to one or more current standards for electronic documents such as EDIFACT or ASC X12; and/or to similar standards issued by other recognized bodies including commercial or financial organizations such as Society for Worldwide Interbank Financial Telecommunication (SWIFT). Other current standards capable of use for electronic data interchange include XML and other modern protocols such as Document Object Model (DOM), Microsoft's (Trade Mark) MSXML and a standard called XHTML 1.0 provided by World Wide Web Committee (W3C). Thus the purchase order is in the form of a development that otherwise corresponds to a traditional EDI type 850 electronic purchase order document. As such, the file transmitted containing the purchase order comprises necessary details such as any of:
-identification of document type
-authorization details,
-security details,
-contact details,
-acknowledgement request details,
-cancellation details
-contract references for seller, manufacturer,
-ordered item identification,
-UPC reference,
-delivery details, carrier and options.

Although a preferred embodiment of the method and apparatus of the present invention has been illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it will be understood that the invention is not limited to the embodiment disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth and defined by the following claims.

CLAIMS

1. A method for procurement of an industrial product in which an apparatus specification is selected and at least one design parameter for said industrial product is calculated, **characterised** by:
-communicating the design parameter calculated from said apparatus specification,
-transferring the apparatus specification upon which said design parameter was calculated from to a purchase process,
-receiving the said specification in the purchase process,
-presenting price and conditions based on said apparatus specification as a decision to buy said industrial product,
-processing a decision to buy said industrial product according to said apparatus specification.

2. A method according to claim 1, **characterised** in that said apparatus specification for said industrial product is communicated to the purchase process by means of a single action.

3. A method according to claim 1, **characterised** by the steps of:
-calculating a price for said electrical according to said apparatus specification,
-communicating the price calculated for said apparatus specification to a prospective customer,
-processing a decision to buy said industrial product carried out by means of a single action by the prospective customer.

4. A method according to claim 1, **characterised** in that it is carried out by a prospective customer for the electrical apparatus.

5. A method according to claim 1, **characterised** in that it is carried out by an employee or agent of the company providing said industrial product.

6. A method according to claim 3, **characterised** by the further steps of:
-communicating said apparatus specification for said industrial product to one or more manufacturers or suppliers engaged in providing said industrial product in the form of an order by means of a single action.

7. A method according to claim 3, **characterised** by the further steps of:
-communicating the apparatus specification for said industrial product to a sales and marketing coordinating system.

8. A method according to claim 6, **characterised** by the further steps of:
-communicating a receipt of the order for said industrial product by the one or more manufacturers or suppliers and associated details to the sales and marketing coordinating system.

9. A method according to claim 6, **characterised** by the further steps of:
-communicating delivery information and confirming associated details of the ordered said industrial product to the purchaser.

10. The method of Claim 1, **characterised** by the further steps of:
-changing at least one apparatus specification selected and associated with at least one design parameter for said industrial product,
-carrying out a repeated calculation of a design parameter for the new apparatus specification.

11. The method of Claim 10, **characterised** by the further step of storing information comprising said industrial product, the last apparatus specification evaluated, the user identity and a time stamp in a user history database.

12. The method of Claim 1, **characterised** by the further steps of:
-examining one or more prices and conditions displayed by the purchase process for the specification
-forming a negative buying decision,
-changing at least one part of said apparatus specification,
-re-running the calculation of the design parameter,
-examining a new price displayed by the purchase process for a new apparatus specification,
-forming a positive buying decision by means of a single action by the user.

13. The method of Claim 1, **characterised** by the further steps of:
-performing iterations of the calculation of the design parameter in which apparatus specification elements or performance factors are changed,
-comparing each calculation result with a predetermined parameter value,
-communicating an optimized apparatus specification for said industrial product to the purchase process.

14. A method according to claim 1, **characterised** in that the design parameter is environmental cost and it is calculated from:
-inputting at least one performance parameter associated with said industrial product,
-calculating an energy loss value or energy consumption value associated with said at least one performance parameter and a predetermined period of time for said industrial product,
-selecting a geographical region associated with a predetermined blend of electricity and an emission profile;
-calculating an emission to energy loss or consumption ratio based on said predetermined blend of electricity and said emission profile;
-assigning a monetary value for at least one emission value from said emission profile; and
-calculating a first environmental cost based on said calculated energy loss value or energy consumption value, said emission to

energy loss or consumption ratio, and said assigned monetary value for said at least one emission value.

15. The method of Claim 14, **characterised** by further comprising the step of calculating a present value for said first environmental cost.

16. The method of Claim 14, **characterised** by further comprising the step of calculating a net discounted cash flow for said first environmental cost.

17. The method of Claim 14, **characterised** in that said first environmental cost comprises an emission cost associated with energy losses or energy consumption replaced by electricity generated in said region.

18. The method of Claim 14, **characterised** by further comprising the steps of:
-calculating a second environmental cost for a second industrial product,
-comparing said first environmental cost and said second environmental cost.

19. The method of Claim 1, **characterised** in that said industrial product comprises a power generating apparatus.

20. The method of Claim 1, **characterised** in that said industrial product comprises a wind-driven power generating apparatus.

21. The method of Claim 1, **characterised** in that said industrial product comprises a fuel cell.

22. The method of Claim 1, **characterised** in that said industrial product comprises a power transmission apparatus.

23. The method of Claim 1, **characterised** in that said industrial product comprises a DC power transmission cable.

24. The method of Claim 1, **characterised** in said industrial product comprises a wind-driven power generating apparatus, a DC power transmission cable and a DC/AC converter.

25. The method of Claim 1, **characterised** in that said industrial products comprises an energy storage system including a gas.

26. The method of Claim 1, **characterised** in that said industrial product comprises an energy storage system including a gas and at least one fuel cell.

27. The method of Claim 1, **characterised** in that said industrial product comprises a power generating apparatus comprising any one or more of a solar cell, a heat pump, a tidal energy machine.

28. The method of Claim 1, **characterised** in that said industrial product comprises a power distribution apparatus.

29. The method of Claim 1, **characterised** in that said industrial product comprises a power transformer.

30. The method of Claim 1, **characterised** in that said industrial product includes an air cooled power transformer apparatus in which at least one winding comprises an insulation system consisting of a inner semiconducting layer in electrical contact with a conductor, an outer layer of semiconducting material at a controlled electrical potential along its length and an intermediate layer of solid electrically insulating material positioned between the inner and outer semiconducting layers.

31. The method of Claim 1, **characterised** in that said industrial product comprises a power consuming apparatus.

32. The method of Claim 1, **characterised** in that said industrial product comprises a power supply unit.

33. The method of Claim 1, **characterised** in that said industrial product comprises an industrial control system.

34. The method of Claim 1, **characterised** in that said industrial product comprises an industrial process control system.

35. The method of Claim 1, **characterised** in that said industrial product comprises an industrial manufacturing process system such as a semiconductor plant, a nano machine component plant or a micro electro-mechanical system plant.

36. The method of Claim 1, **characterised** in that said industrial product comprises a motor.

37. The method of Claim 1, **characterised** in that the method for economically valuating the environmental impact of said industrial product is included in a reply to an industrial request for a quote (RFQ).

38. A procurement system for an industrial product, in which a design parameter dependent on at least one apparatus specification is calculated and evaluated, including a means for displaying information including the apparatus specification for said industrial product and a means for communication with interested parties over a network, **characterised** in that the system comprises:
-a further system for providing a financial valuation of the environmental impact of a parameter of at least one said electrical apparatus,
-means for communicating with a single action the apparatus specification for said electrical apparatus to a buying decision in a purchase process,

-means for calculating and communicating a price for said industrial product based on the apparatus specification communicated,

-means for making a decision to buy said industrial product with a single action according to the price and conditions calculated based on said apparatus specification.

39. A procurement system according to claim 38, **characterised** in that the system includes means for communicating the specification for said electrical apparatus to one or manufacturers or suppliers of the electrical apparatus or part or related service thereof.

40. A procurement system according to claim 38, **characterised** in that the further system for providing a financial valuation of the environmental impact comprises:

-a processor; and

-database coupled to said processor, said database including information associated with an environmental impact of an industrial product as an electrical system, equipment or product, information associated with a characteristic electricity blend for each one of a plurality of regions, and an inventory of resources and emissions associated with said at least one electrical apparatus for at least one of a plurality of life cycle phases, said processor operable to:

-input at least one performance parameter associated with said at least one electrical apparatus;

-calculate an energy loss value or energy consumption value associated with said at least one performance parameter and a predetermined period of time for said at least one apparatus;

-select a geographical region associated with a predetermined blend of electricity and an emission profile;

-calculate an emission to energy loss or consumption ratio based on said predetermined blend of electricity and said emission profile;

-assign a monetary value for at least one emission value from said emission profile; and

-calculate a first environmental cost based on said calculated energy loss value or energy consumption value, said emission to energy loss or consumption ratio, and said assigned monetary value for said at least one emission value.

41. The system of Claim 38, **characterised** in that it comprises at least one user history database (1211) in which history details of a given apparatus specification selection, and subsequent changes to said given apparatus specification per each user and prospective customer, are identified, time stamped and stored for retrieval and analysis.

42. The system of Claim 38, **characterised** in that it comprises software means to match a registered or identified logged-in prospective customer to a history of details of apparatus specification selection, and subsequent changes to apparatus specification stored in a database (1211) of the system.

43. The system of Claim 38, **characterised** in that it comprises software means to match a registered or identified logged-in prospective customer to a history of details of apparatus specification selection comprising digital identifier means such as a cookie stored in a computer used by the prospective customer.

44. The system of Claim 38, **characterised** in that said processor is further operable to:
-calculate a second design parameter for a second said industrial product, and
-compare said design parameter value and said design parameter value.

45. The use of the system of Claim 38, for performing a comparison of at least two power generating apparatuses.

46. The use of the system of Claim 38, for performing a comparison of at least two power generating apparatuses of which at least one includes an energy storage system.

47. The use of the system of Claim 38, for performing a comparison of at least two power generating apparatuses of which at least one includes a fuel cell.

48. The use of the system of Claim 38, for performing a comparison of at least two power generating apparatuses of which at least one includes any of a solar cell, a heat pump, a tidal energy machine.

49. The use of the system of Claim 38, for performing a comparison of at least two power transmission apparatuses.

50. The use of the system of Claim 38, for performing a comparison of at least two power transmission apparatuses of which at least one includes a DC power transmission cable.

51. The use of the system of Claim 38, for performing a comparison of at least two power distribution apparatuses.

52. The use of the system of Claim 38, for performing a comparison of at least two power transformer apparatuses.

53. The use of the system of Claim 38, for performing a comparison of at least two power consumption apparatuses.

54. The use of the system of Claim 38, for performing a comparison of at least two motors.

55. The use of the system of Claim 38, for performing a comparison of at least two industrial products as a part of a process for buying an industrial product.

56. A computer program code element, comprising computer code means or software code portions for enabling a computer or a processor to model, calculate or determine a design parameter dependent on an apparatus specification of at least one industrial product, **characterised** in that said computer or processor carries out actions to:
-receive a data input representing at least one apparatus specification;
-retrieve information from a database including design parameters related to a apparatus specifications for pre-determined set of components comprising said industrial product;
-perform a calculation of said design parameter value dependent on said at least one apparatus specification;
-display a value for said design parameter;
-communicate to a purchase process the apparatus specification on which the displayed value for said design parameter is based,
-communicate a price and conditions for the apparatus specification,
-process a decision to buy an industrial product for the price communicated.

57. The computer program code element of Claim 56, **characterised** in that the computer code means or software code portions comprise software means enabling a user to:
-change a component,
-change an apparatus specification,
-carry out a repeated evaluation of said design parameter for the new specification
-calculate a value for said design parameter of the new specification.

58. The computer program code element of Claim 56, **characterised** in that the computer code means or software code portions comprise software means enabling a user to:

-carry out a repeated optimization said design parameter for the new apparatus specification until the value is equal to or less than a predetermined target value.

59. The computer program code element of Claim 56, **characterised** in that the computer code means or software code portions comprise software means to identify a stored user history for a currently logged in user and insert a selectable part of a previous apparatus specification and or design parameter calculation of the stored user history into a current evaluation process.

60. The computer program code element of Claim 56, **characterised** in that the computer code means or software code portions comprise software means enabling a user to send an apparatus specification upon which said at least one design parameter depends forward to a purchase process with a single action by a user.

61. The computer program code element of Claim 56, **characterised** in that the computer code means or software code portions comprise software means enabling a user to communicate a buying decision, based on one or more prices and conditions resulting from the purchase process for the selected apparatus specification, by means of a single action by the user.

62. The computer program code element of Claim 56, **characterised** in that the computer code means or software code portions comprise software means to communicate a decision to buy an industrial product according to the apparatus specification upon which said at least one design parameter depends as a purchase order to a predetermined manufacturer.

63. The computer program code element of Claim 56, **characterised** in that the computer code means or software code portions comprise executable parts formed written in as one or more object oriented programs and accessible and implementable over a network such as the Internet.

64. The use of the computer program code element of Claim 56 over a network such as the Internet by a prospective customer to evaluate a design parameter of one or more components of an industrial product in order to make a buying decision.

65. A computer program contained on a computer readable medium, comprising computer program code means to make a computer or processor carry out the steps of allowing a user to:
-select an industrial product as a system,
-select one or more components,
-specify an apparatus specification for one or more components,
-evaluate the industrial product or system,
-send the apparatus specification to a purchase process,
-receive a price
-make a buying decision
-communicate the buying decision to a manufacturer.

66. A web site or web server comprising means for providing a purchase process for at least one industrial product, including information about said industrial product, **characterised** in that said web site comprises access to computer program means such as HTML or XHTML or XML compatible code for executing the actions of:
-allowing a user or computer access to information about products including said industrial product,
-selecting one or more components of said industrial product
-selecting an apparatus specification for said industrial product,
-evaluating at least one design parameter for said industrial product according to said apparatus specification,
-calculating a value for the at least one design parameter,
-displaying design parameter value result,
-providing means for the user to transfer said apparatus specification to said purchase process by means of a single action.

67. A web site or web server according to Claim 66, **characterised** by comprising computer program means for processing a decision

made by the user to buy said industrial product according to said apparatus specification and thereby procure it.

68. A web site or web server according to Claim 66, **characterised** by comprising computer program means for:
-providing a registration process for a first time prospective buyer,
-providing log-in means for a pre-registered person or computer.

69. A web site or web server according to Claim 66, **characterised** by comprising computer program means for:
-providing a software means to retrieve and present for an identified logged-in user or computer a history of previous selections and optimisations made by same and stored in a database accessible by the web site so that the same analysis may be re-examined and/or continued.

70. A web site or web server according to Claim 66, **characterised** by comprising computer program means for:
-communicating a purchase order to a pre-determined manufacturer or supplier for at least part of a purchase based on said specification for said industrial product.

71. A web site or web server according to Claim 70, **characterised** in that the purchase order conforms to one or more standards for electronic documents such as EDIFACT, ASC X12, or other standards such as XHTML 1.0, DOM level 3, SWIFT EDI.

72. A method to optimize a specification for an industrial product in which an apparatus specification is selected and at least one design parameter for said industrial product is calculated, **characterised** by:
-communicating the design parameter calculated from said apparatus specification,
-transferring the apparatus specification upon which said design parameter was calculated from to a purchase process,

-receiving the said specification in the purchase process,
-presenting price and conditions based on said apparatus specification as a decision to buy said industrial product,
-processing a decision to buy said industrial product according to said apparatus specification.

73. A method according to claim 72, **characterised** by the further steps of:
-communicating said apparatus specification for said industrial product to one or more manufacturers or suppliers engaged in providing said industrial product in the form of an order by means of a single action.

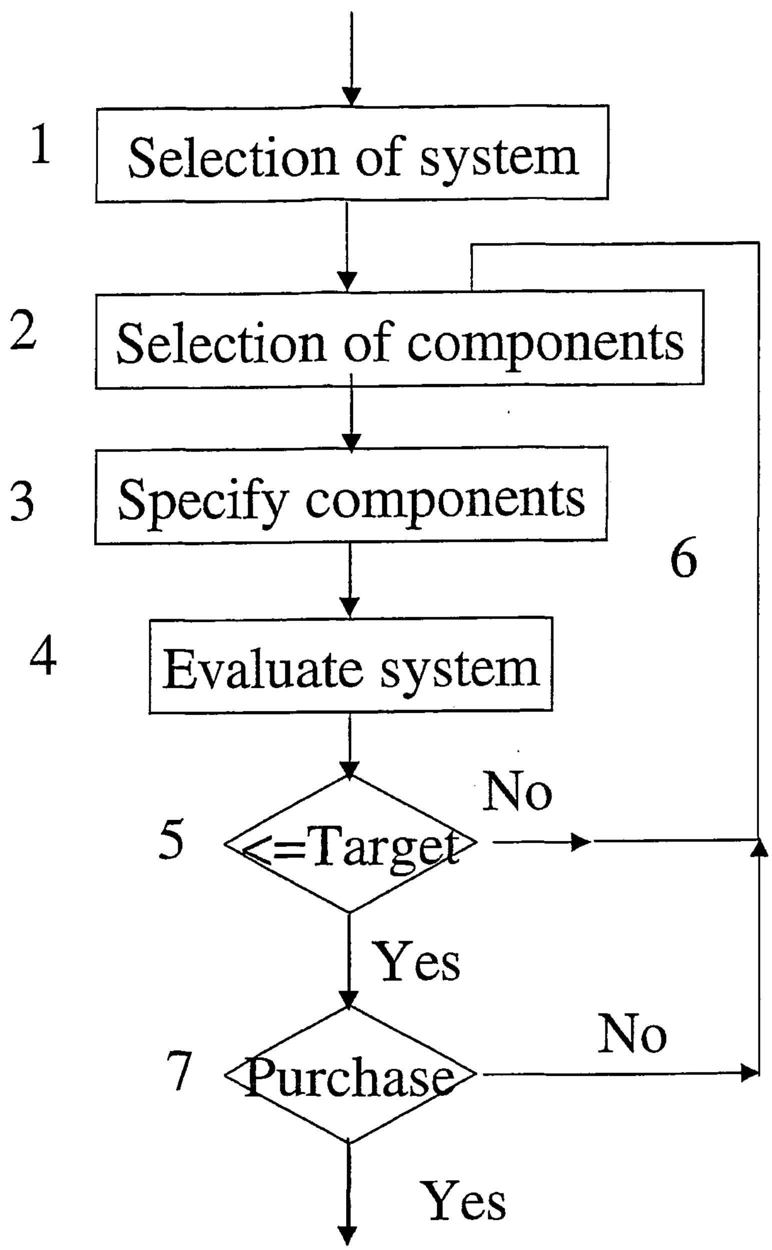

1
Selection of system
2
Selection of components
3
Specify components
6
4
Evaluate system
No
5
<=Target
Yes
No
7
Purchase
Yes

Figure 1

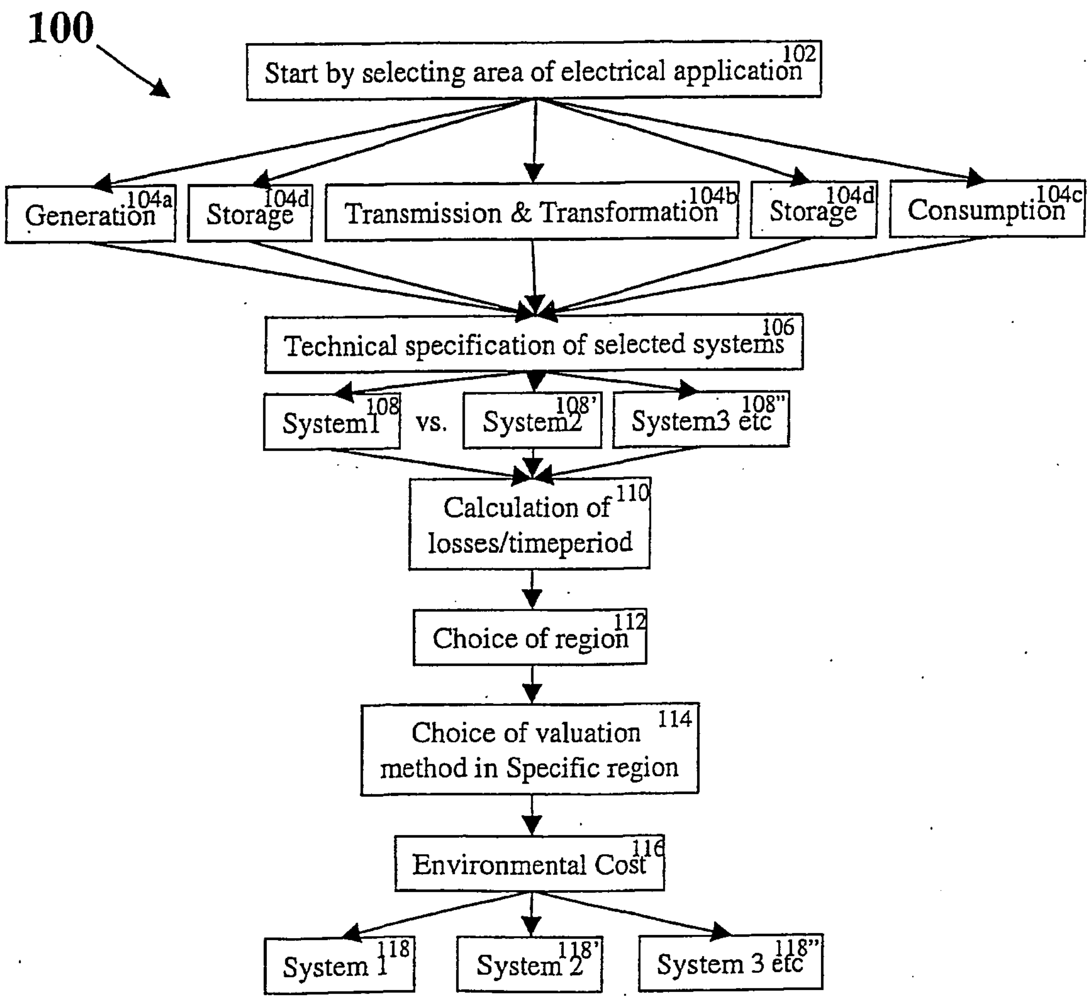

100
Start by selecting area of electrical application 102
Generation 104a
Storage 104d
Transmission & Transformation 104b
Storage 104d
Consumption 104c
Technical specification of selected systems 106
System1 108
vs.
System2 108'
System3 etc 108"
Calculation of losses/timeperiod 110
Choice of region 112
Choice of valuation method in Specific region 114
Environmental Cost 116
System 1 118
System 2 118'
System 3 etc 118"

Figure 2A

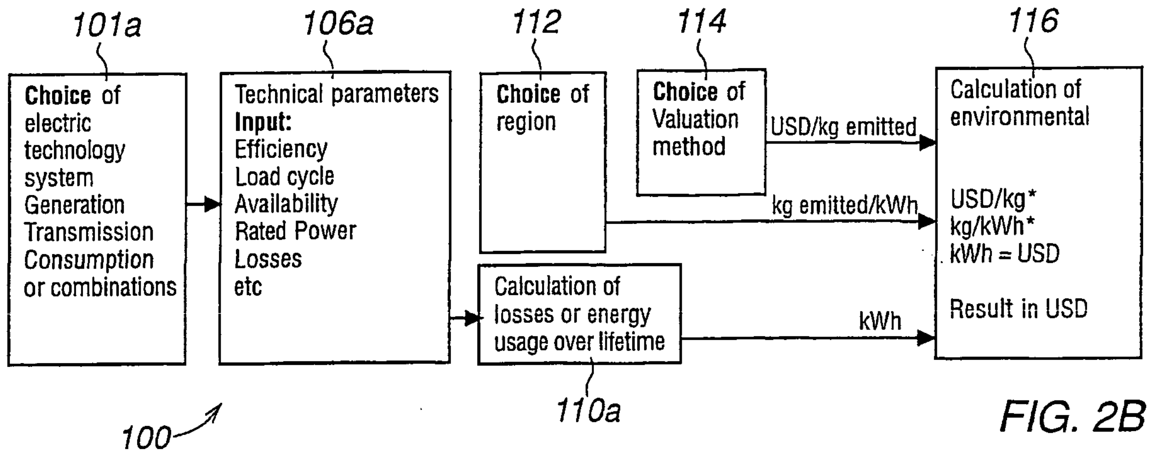


FIG. 2B

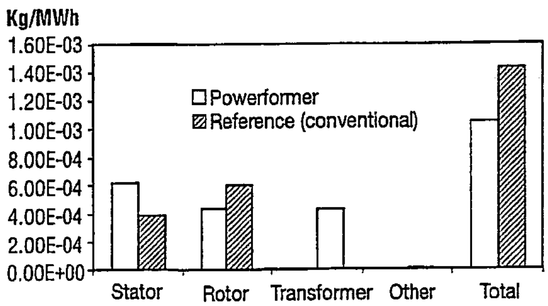


FIG. 3A

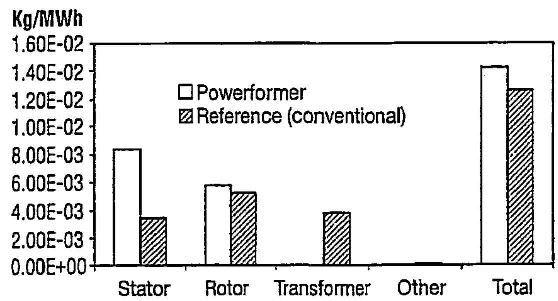


FIG. 3B

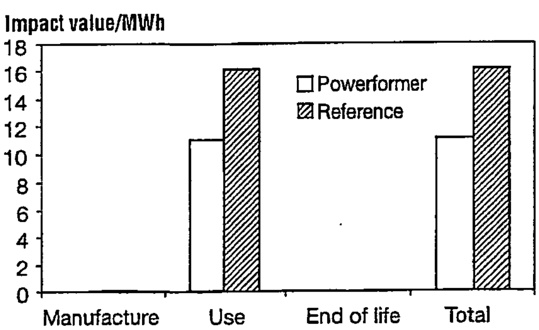


FIG. 4A

Fig. 4a

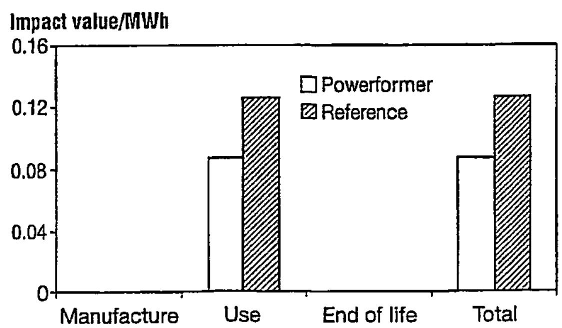


FIG. 4B

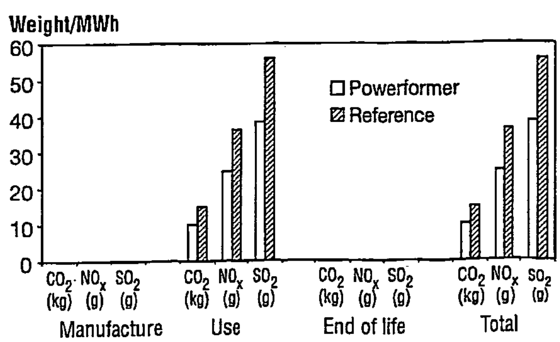


FIG. 5

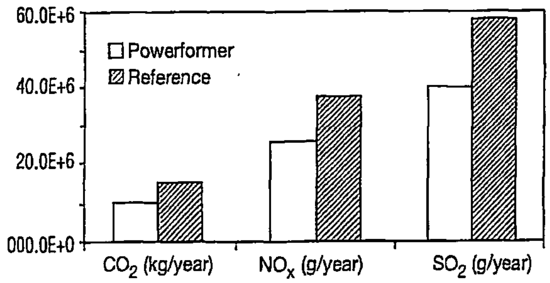


FIG. 6A

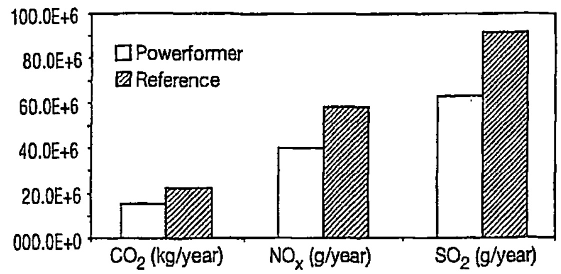


FIG. 6B

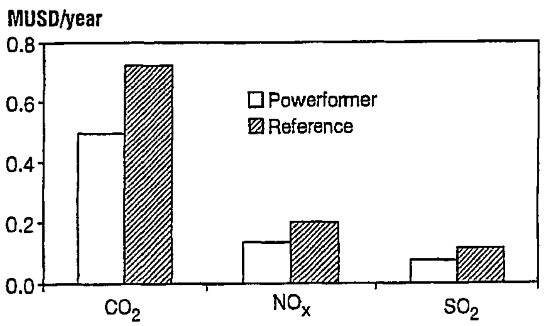


FIG. 7A

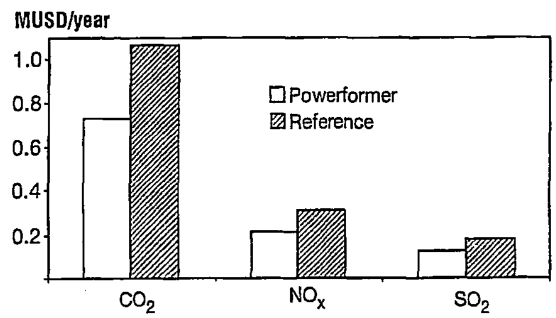


FIG. 7B

	Powerformer	Reference	Difference
CO_2	8.6	12.4	3.9
NO_x	2.4	3.5	1.1
SO_2	1.4	2.0	0.6

FIG. 8A

	Powerformer	Reference	Difference
CO_2	12.6	18.4	5.7
NO_x	3.7	5.4	1.7
SO_2	2.2	3.2	1.0

FIG. 8B

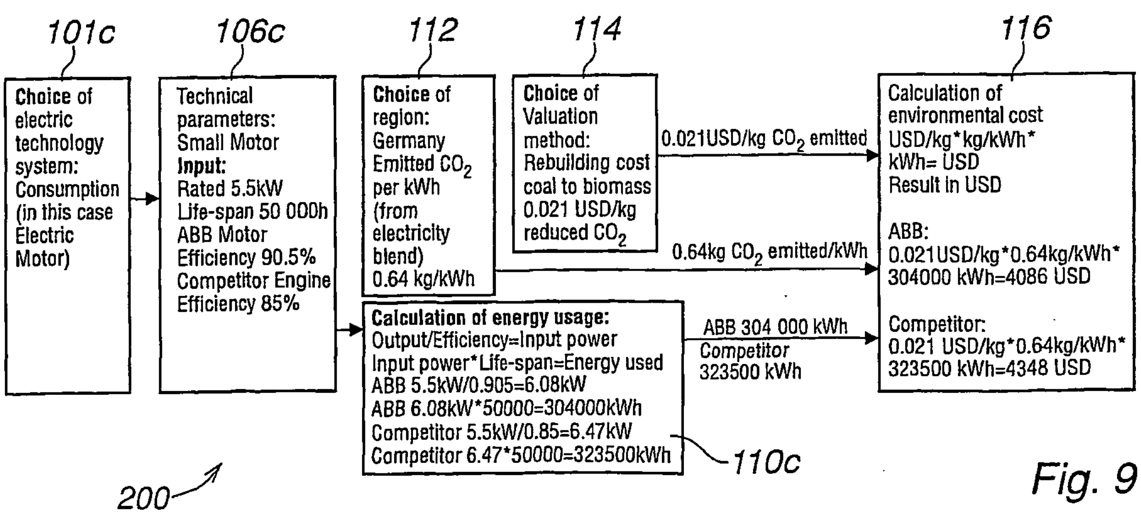


Fig. 9

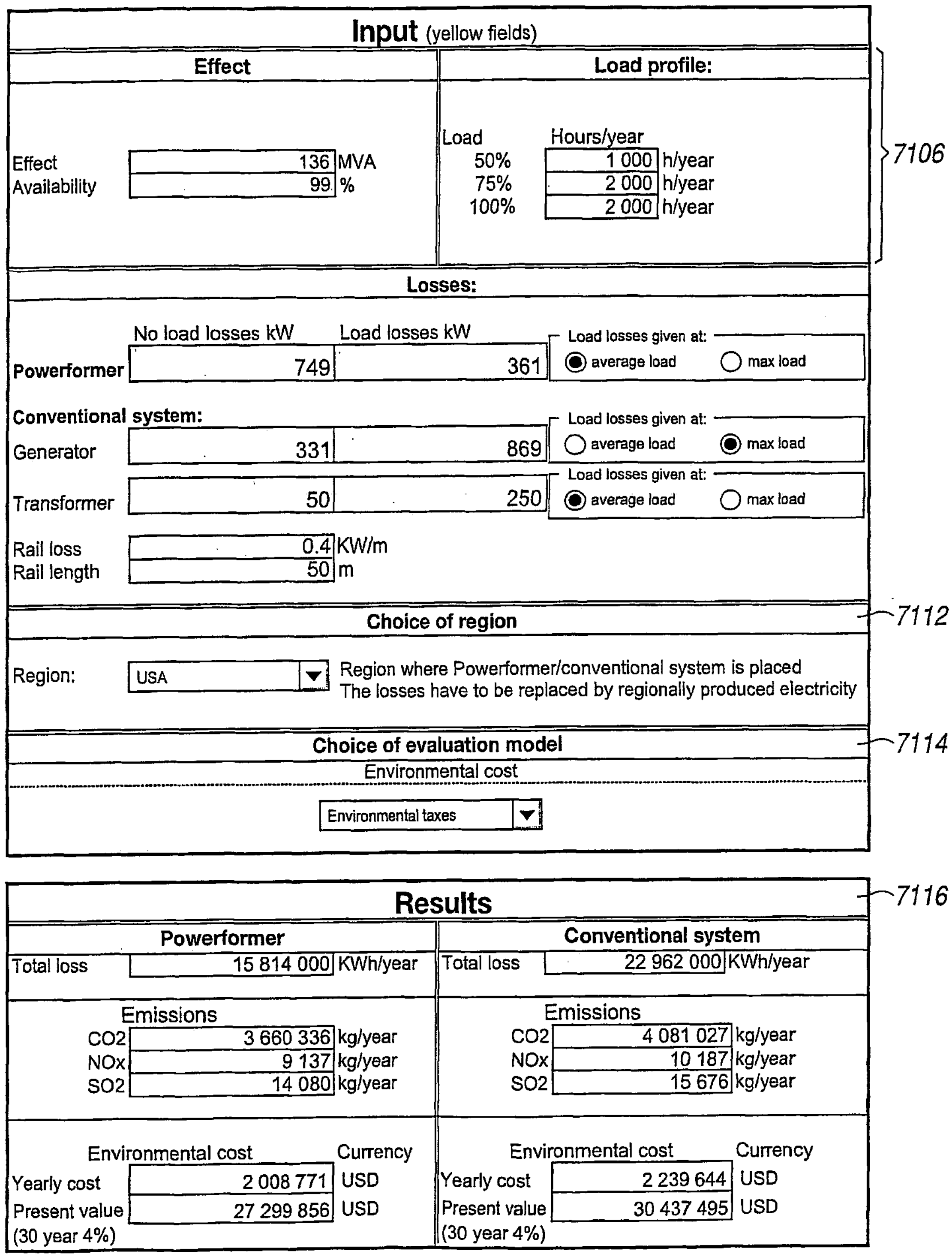

Input (yellow fields)
Effect
Load profile:
Effect 136 MVA
Availability 99 %
Load Hours/year
50% 1 000 h/year
75% 2 000 h/year
100% 2 000 h/year
7106
Losses:
No load losses kW
Load losses kW
Powerformer 749 361
Load losses given at:
average load
max load
Conventional system:
Generator 331 869
Transformer 50 250
Rail loss 0.4 KW/m
Rail length 50 m
Choice of region
7112
Region: USA
Region where Powerformer/conventional system is placed
The losses have to be replaced by regionally produced electricity
Choice of evaluation model
7114
Environmental cost
Environmental taxes
Results
7116
Powerformer
Conventional system
Total loss 15 814 000 KWh/year
Total loss 22 962 000 KWh/year
Emissions
CO2 3 660 336 kg/year
NOx 9 137 kg/year
SO2 14 080 kg/year
CO2 4 081 027 kg/year
NOx 10 187 kg/year
SO2 15 676 kg/year
Environmental cost
Currency
Yearly cost 2 008 771 USD
Present value 27 299 856 USD
(30 year 4%)
Yearly cost 2 239 644 USD
Present value 30 437 495 USD
(30 year 4%)

FIG. 7C

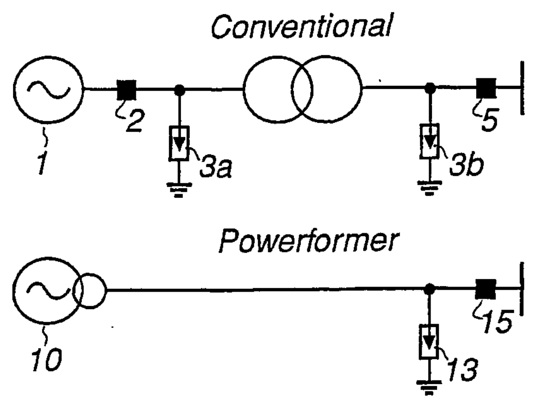
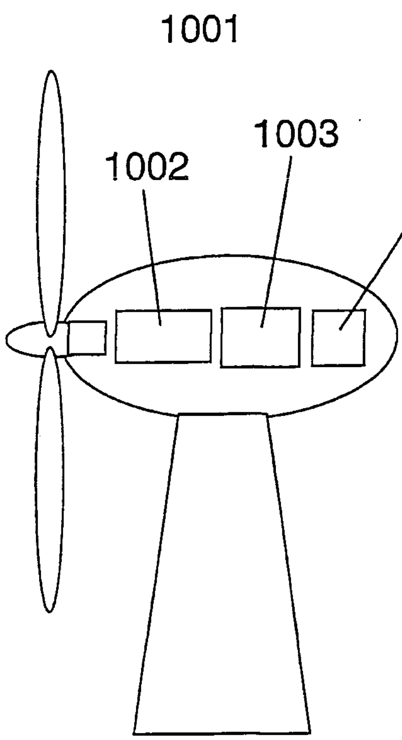
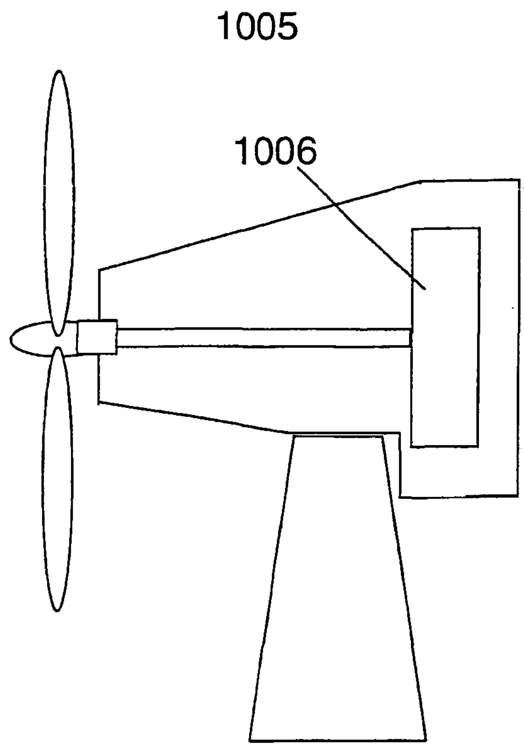


FIG.10A


1001
1002
1003
1004


1005
1006

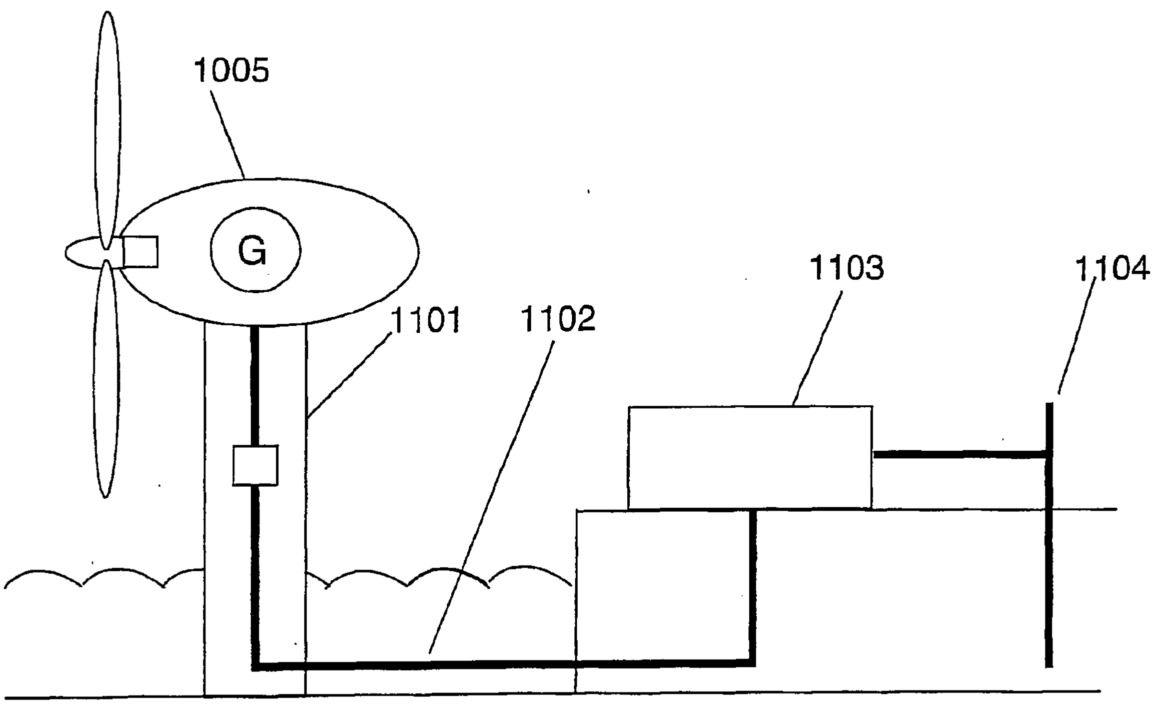


Figure 11

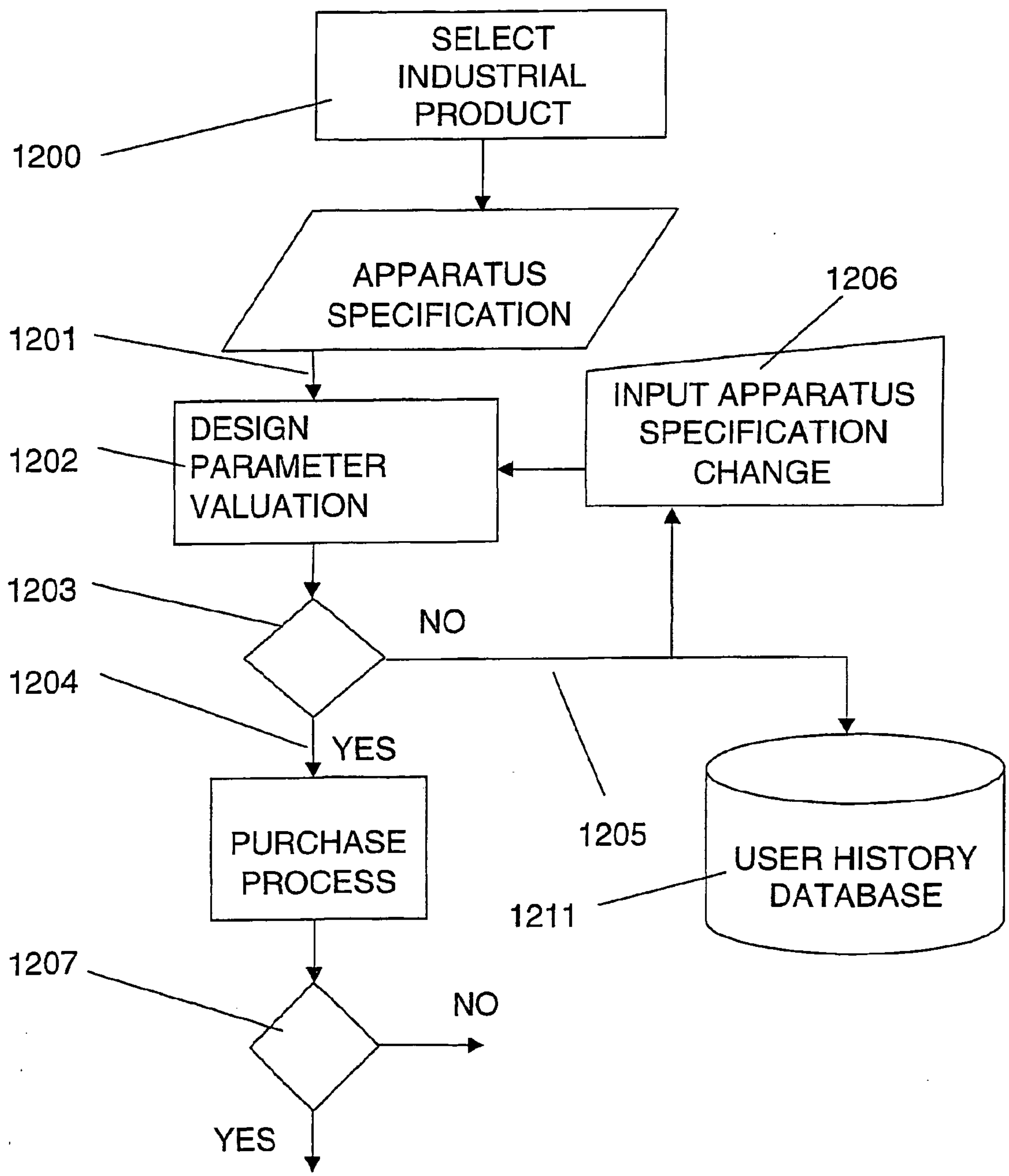

SELECT INDUSTRIAL PRODUCT
1200
APPARATUS SPECIFICATION
1201
1206
INPUT APPARATUS SPECIFICATION CHANGE
DESIGN PARAMETER VALUATION
1202
1203
NO
1204
YES
1205
PURCHASE PROCESS
USER HISTORY DATABASE
1211
1207
NO
YES

Figure 12

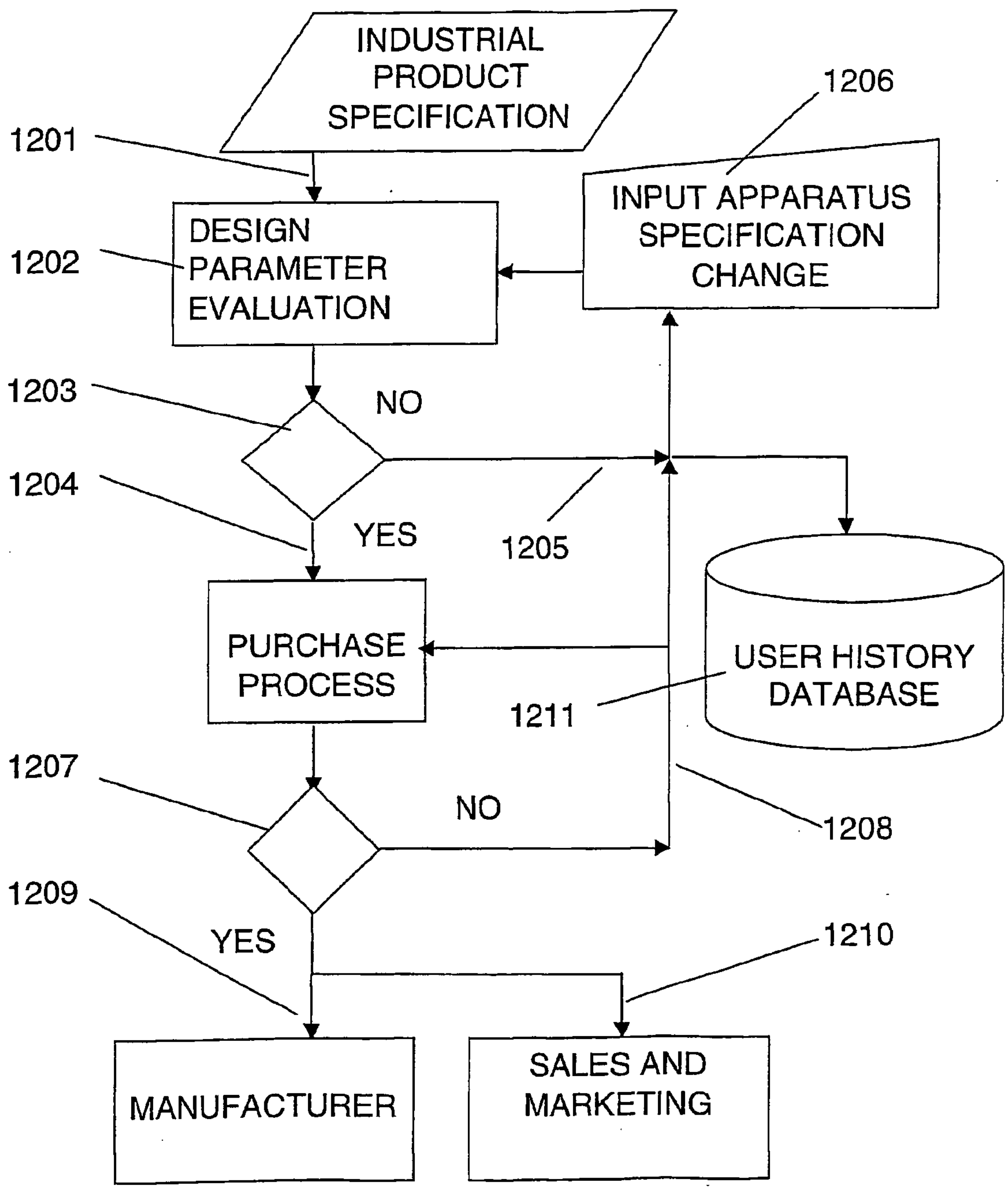

INDUSTRIAL PRODUCT SPECIFICATION
1201
1202
DESIGN PARAMETER EVALUATION
1206
INPUT APPARATUS SPECIFICATION CHANGE
1203
NO
1204
YES
1205
USER HISTORY DATABASE
PURCHASE PROCESS
1211
1207
NO
1208
1209
YES
1210
MANUFACTURER
SALES AND MARKETING

Figure 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/01974

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: G06F 17/60

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
---	JP 10312419 A (HITACHI LTD), 24 November 1998 (24.11.98), whole document --	1-71
---	JP 07311760 A (NEC CORP), 28 November 1995 (28.11.95), whole document --	1-71
---	US 5404314 A (KNUPP), 4 April 1995 (04.04.95), whole document --	1-71
---	US 5546564 A (HORIE), 13 August 1996 (13.08.96), whole document --	1-71

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 January 2002	17-01-2002

Name and mailing address of the ISA/	Authorized officer
Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Erik Veillas/LR Telephone No. +46 8 782 25 00

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
---	US 5852560 A (TAKEYAMA ET AL), 22 December 1998 (22.12.98), whole document --	1-71
---	US 5960411 A (HARTMAN ET AL), 28 Sept 1999 (28.09.99), whole document -- --------	1-71

INTERNATIONAL SEARCH REPORT

International application No.
SE01/01974

Box I **Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: 1-71
because they relate to subject matter not required to be searched by this Authority, namely:
see extra sheet

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II **Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest ☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.

Continuation of Box I:1.

The subject matter claimed in claims 1-37 and 70-71 falls under the provision of Article 17(2)(a)(i) and Rule 39.1(iii), PCT, such subject matter relating to a method of doing business.

More precisely, claims 1-37 and 70-71 concern a method for procurement of an industrial product.

The method according to claims 1- 37 and 70-71 involves mainly presenting price and conditions based on a apparatus specification in order to support a decision of buying an industrial product. The decision is "processed" according to the apparatus specification. The wordings "processing a decision" is vague and is not considered to confer any technical character to the method according to claims 1-37, and 70-71.

Calculating design parameters can be performed with mental calculus. Transferring apparatus specification and presenting prices can be performed by physically meeting a potential purchaser. Hence, the indicated method steps do not involve any technical features.

Claims 38-53 claim protection for a procurement system which uses conventional technical means (a processor and a database according to claim 40) to realize the steps of the non-technical method.

Claims 54-69 claim protection for a computer program and the use thereof, and a web site implementing the non-technical method.

The disclosure of the invention shall reveal the technical problem the invention is supposed to solve, see Rule 5.1(iii) PCT.

The definition of the matter for which protection is sought shall be in terms of the technical features of the invention, see Rule 6.3(a) PCT.

Furthermore, the manner of claiming of claims 1-13 and 38-39 does not provide any details concerning the actual implementation; it merely describes what is performed/included and not how the implementation is accomplished. This lack of concise information lead to the conclusion that claims 1-13 and 38-39 lack clarity and conciseness in the meaning of article 6, PCT.

.../...

However, a novelty search concerning the technical content of the application has been performed, mainly focusing on the subject matter claimed in claims 14 and 40.

As it is not at present apparent how the subject matter of the present claims 1-71 may be considered with regard to the provisions of article 33(1), PCT (novelty, inventive step), the found prior art documents concerning these claims are left without category.

It is pointed out that the subject matter of the claimed invention and the lack of technical character of the patent application as defined by claims 1-71 may, by a plurality of National Patent Offices, be considered as being out of the scope of the patentable field.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/01974

Patent document cited in search report			Publication date	Patent family member(s)			Publication date
JP	10312419	A	24/11/98	NONE			
JP	07311760	A	28/11/95	NONE			
US	5404314	A	04/04/95	NONE			
US	5546564	A	13/08/96	JP	7091083	A	04/04/95
US	5852560	A	22/12/98	DE	19722741	A	11/12/97
				FR	2749414	A,B	05/12/97
				JP	10057936	A	03/03/98
US	5960411	A	28/09/99	AU	9477998	A	29/03/99
				CA	2246933	A	12/03/99
				CA	2263781	A	12/03/99
				EP	0902381	A	17/03/99
				EP	0927945	A	07/07/99
				EP	1134680	A	19/09/01
				JP	11161717	A	18/06/99
				JP	2000099592	A	07/04/00
				WO	9913424	A	18/03/99